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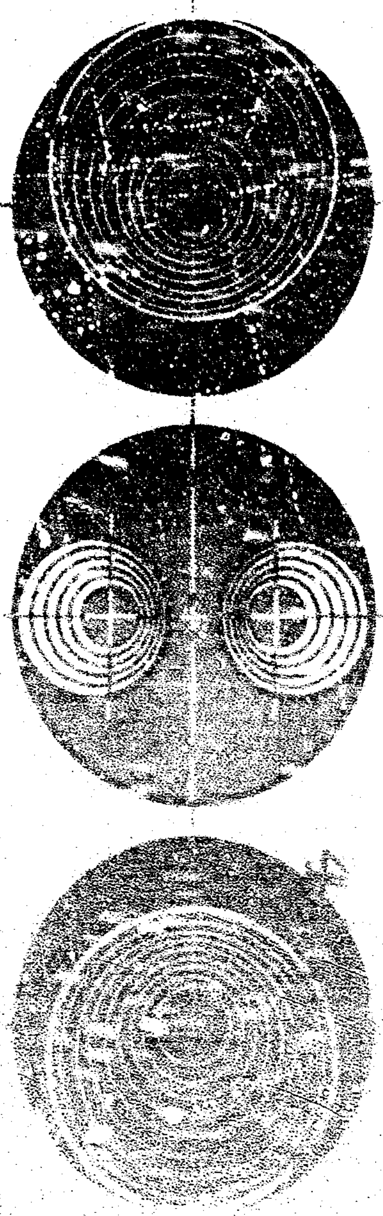
PROGRAM 624A QUARTERLY RELIABILITY AND QUALITY ASSURANCE REPORT

VOLUME I: RELIABILITY

JULY 1966



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MARTIN COMPANY
A DIVISION OF MARTIN MARIETTA CORPORATION
Denver, Colorado

prepared for

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Air Force Systems Command
Air Force Unit Post Office
Los Angeles, California 90045

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Contract AF04(695)-150

PROGRAM 624A QUARTERLY RELIABILITY AND QUALITY ASSURANCE REPORT VOLUME I: RELIABILITY

July 1966

Prepared by
Systems Reliability

Approved

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Quality/Systems Effectiveness

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Denver, Colorado

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FOREWORD

This document is submitted under Item 1, Exhibit A, Task 5.13, of Contract AF04(695)-150 in accordance with Line Item 1U-19 of Contractor Specification SSS-TIII-010 DRD (Rev 3), dated 15 April 1963, and DSCN 1 thru 145.

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<u>Figure</u>

Table

SUMMARY

This document is the Reliability portion of the Quarterly Reliability and Quality Assurance Report for the second quarter of 1966.

The Reliability Measurement Section has been updated to include the latest applicable test data and corrective action.

Six previously reported reliability problems and one new reliability problem was worked in this reporting period. Five of the 7 reliability problems were closed during this quarter.

The Design Assurance Test Program progressed on schedule during this reporting period.

Vibration and acoustic data obtained during flight of Article 11 are being analyzed, and the results of this analysis will be incorporated in the flight test reqport on Article 11.

Acoustic and vibration studies on the Vehicle 10 payload were completed during this reporting period with special emphasis placed on the possibility of reducing the acoustic environment within the payload fairing and the study of the sources of acoustic attenuation. A preliminary report of this stuoy was reviewed by Aerospace/SSD at a program status meeting in June, 1966. Final reporting of the study is in progress and is scheduled for completion during the third quarter, 1966.

:oustic, vibration, and shock criteria studies on MOL-HSQ secondary payload, Article 9, progressed on schedule during this quarter and are scheduled for completion during the third quarter, 1966.

I. INTRODUCTION

This report presents the reliability p rtion of the Quarterly Reliability and Quality Assurance Report for the first quarter of 1966. System reliability measurements are presented in Chap. II. Reliability problems are identified and discussed in Chap. III. Summaries of the design studies and reviews conducted during the second quarter of 1966 are included in Chap. IV.

Chapter V presents the status of the design assurance test program and the significant activities of environmental criteria areas. Chapter VI presents the status of the reliability demonstration. Chapter VII summarizes Miscellaneous Reliability Activities for the second quarter of 1966.

II. RELIABILITY MEASUREMENTS

This chapter contains measurements and predictions based on test and failure data received and analyzed as of 30 June 1966.

A. FLIGHT RELIABILITY MEASUREMENTS

Flight reliability measurements (performance criteria) of the Martin portion of Titan III, prepared in accordance with techniques in Reliability Measurement Plan, IR-64-14, are presented in the following figures:

1) Design Reliability Measurement (Performance Criteria) for Martin Portion of Titan III (Configurations A and C) during Flight, Fig. 1;

2) Achieved Reliability Measurement (Performance Criteria) for Martin Portion of Titan III (Configurations A and C) during Flight, Fig. 2.

Reliability measurements for individual subsystems are also summarized in Tables 1 and 2. Qualitative descriptions of problems and subsequent fixes affecting these measurements are included in Table 3.

In addition to the performance measurements, the Flight Reliability Measurement (Mission Objective) for the Martin Portion of Titan III is included. This evaluation represents the probability of success for the Martin portion of Titan III in performing the flight functions required to place a payload into a desired orbit. This evaluation uses gross success and attempt data from Configurations A and C. This evaluation is presented in Fig. 3.

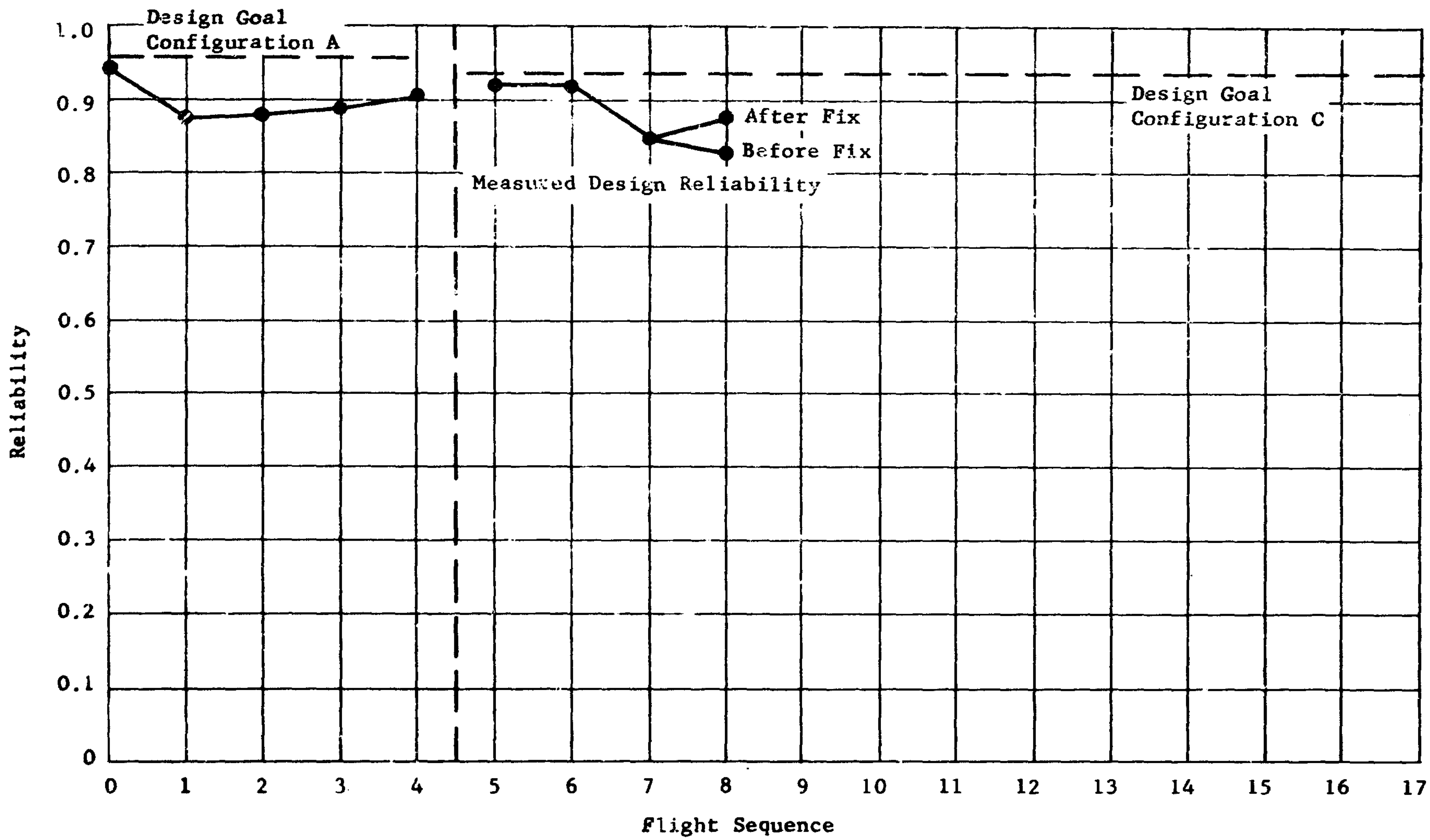

Fig. 1 **Design Reliability Measurement (Performance Criteria) for Martin Portion of Titan III (Configurations A and C) during Flight**

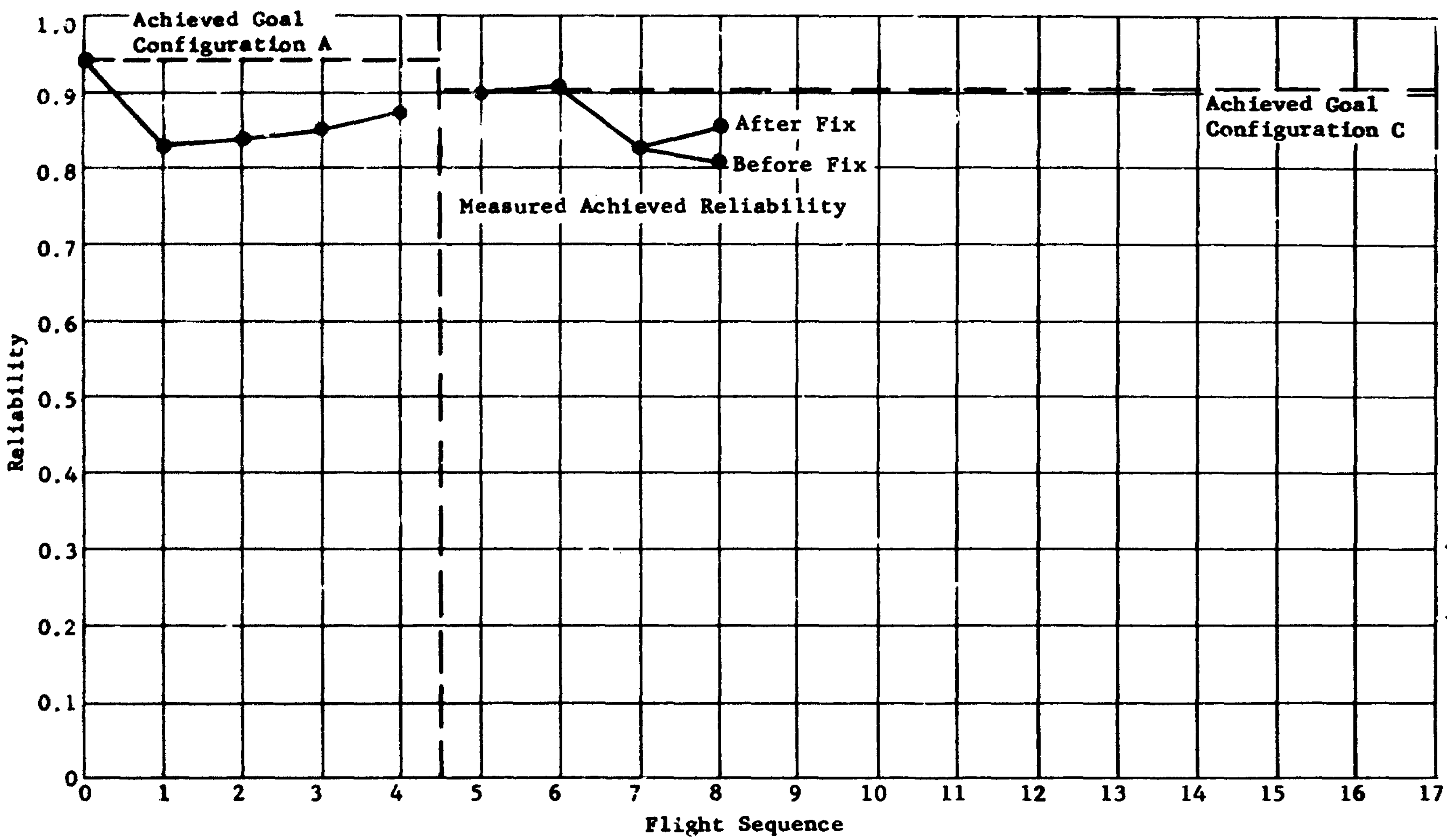

Fig. 2 Achieved Reliability Measurement (Performance Criteria) for Martin Portion of Titan III (Configurations A and C) during Flight

Table 1 Design Reliability Measurements (Performance Criteria) for Individual Subsystems of Titan III (Configurations A and C) during Flight

Martin Subsystem	Design $\bar{R}$ Goal (A)	Before Fix $\bar{R}$ Measurement (A)	After Fix $\bar{R}$ Measurement (A)	Design $\bar{R}$ Goal (C)	Before Fix $\bar{R}$ Measurement (C)	After Fix $\bar{R}$ Measurement (C)
Electrical	0.99768	0.99934	0.99934	0.99341	0.99922	0.99922
Flight Control and Hydraulic	0.99206	0.99589	0.99589	0.97120	0.99602	0.99602
Vehicle Safety	0.99990	0.99996	0.99996	0.99990	0.99995	0.99995
MDS (Secondary)	0.99986	0.99993	0.99993	0.99976	0.99989	0.99989
Structure	0.99030	0.99244	0.99244	0.99497	0.99386	0.99386
Ordnance	0.99930	0.99965	0.99965	0.99927	0.99967	0.99967
Propellant and Pressurization	0.98777	0.95057	0.99730	0.98700	0.93143	0.97597
Attitude Control	0.99475	0.90755	0.90755	0.99462	0.90798	0.90798
Payload Fairing	0.99990	0.99995	0.99995	0.99990	0.99995	0.99995
Total Martin	0 96208	0.85168	0.89356	0.94130	0.83611	0.87610

Table 2 Achieved Reliability Measurements (Performance Criteria) for Individual Subsystems of the Titan III (Configurations A and C) furing Flight

Martin Subsystem	Achieved $\bar{R}$ Goal (A)	Before Fix $\bar{R}$ Measurements (A)	After Fix $\bar{R}$ Measurements (A)	Achieved $\bar{R}$ Goal (C)	Before Fix $\bar{R}$ Measurements (C)	After Fix $\bar{R}$ Measurements (C)
Electrical	0.99665	0.97702	0.99242	0.98895	0.97446	0.98993
Flight Control and Hydraulic	0.98837	0.99326	0.99326	0.95190	0.99407	0.99407
Vehicle Safety	0.99986	0.99992	0.99992	0.99970	0.99984	0.99984
MDS (Secondary)	0.99976	0.99987	0.99987	0.99959	0.99977	0.99977
Structure	0.98180	0.98881	0.98881	0.99150	0.99081	0.99081
Ordnance	0.99800	0.99905	0.99905	0.99790	0.99867	0.99867
Propellant and Pressurization	0.97920	0.94614	0.99263	0.97820	0.92854	0.97293
Attitude Control	0.99112	0.90477	0.90477	0.99090	0.90568	0.90568
Payload Fairing	0.99980	0.99989	0.99989	0.99981	0.99990	0.99990
Total Martin	0.93618	0.82044	0.87432	0.90200	0.80571	0.85762

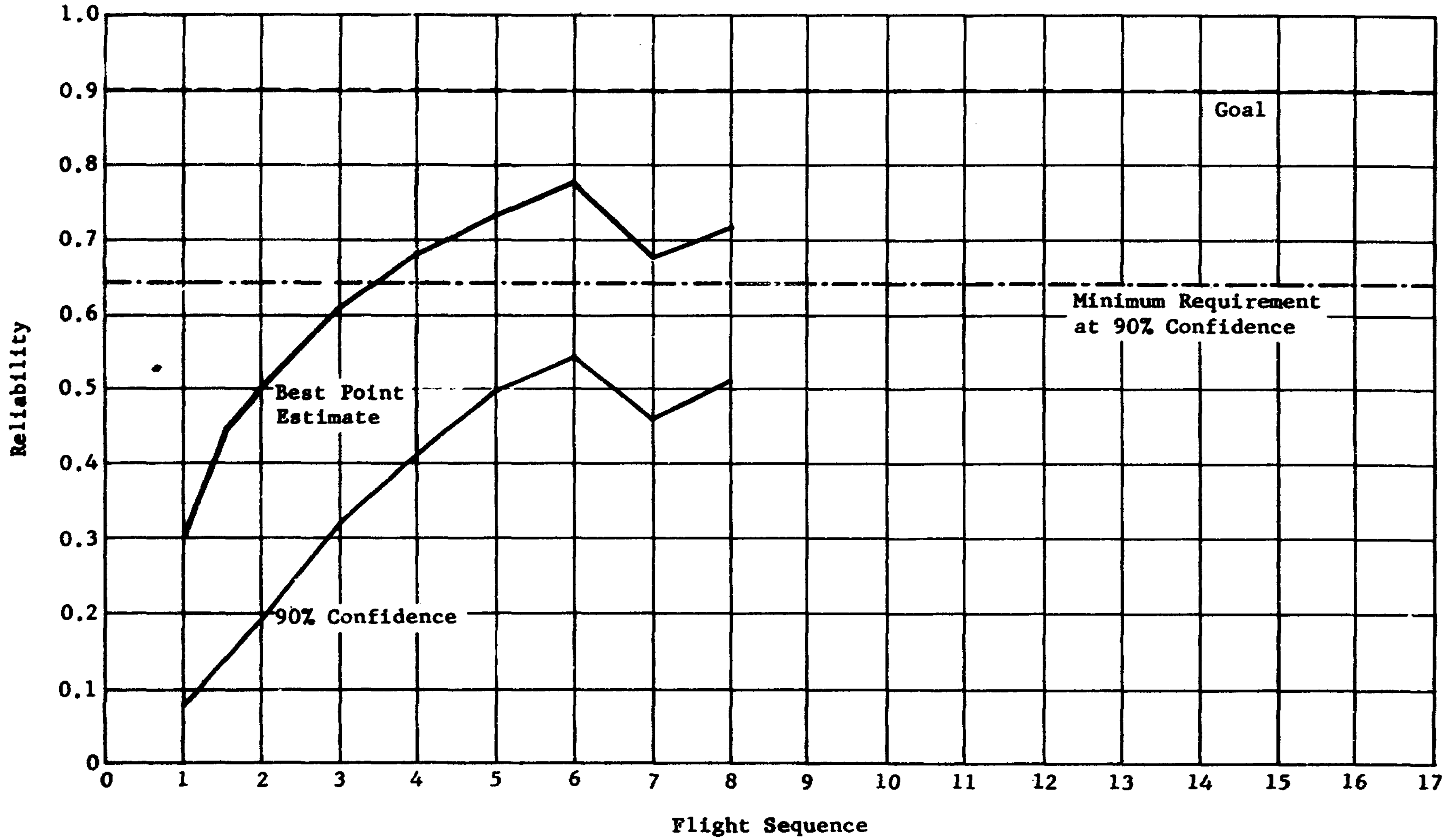

Fig. 3 Reliability Measurement (Mission Objective Criteria) for Martin Portion of Titan III during Flight

B. MALFUNCTION DETECTION SYSTEM RELIABILITY ESTIMATES, PRIMARY FUNCTION

Estimates of achieved and design flight reliability for the malfunction detection system (MDS), primary function vs time, are shown in Fig. 4 and 5. The primary function of the MDS is defined as sensing any impending catastrophic condition and responding with sufficient lead time to abort the spacecraft safely. Techniques used to derive these estimates are included in the appendix. Specific problems causing downward trends are included in Table 4.

C. COUNTDOWN MEASUREMENTS

Countdown reliability is defined as the probability of conducting the countdown (starting at T - 195 min) through SRM ignition, with no holds occurring that would cause a mission abort. The countdown measurement program for the Martin portion of Titan III is oriented toward measurements of the capability of the hardware, procedure, and personnel required to perform the events/functions in the countdown sequence. Although the countdown measurement program based on these criteria will produce pessimistic estimates, it is a more useful tool in determining weaknesses in three major factors: hardware, procedure, and personnel. To clarify the reference to pessimistic estimates, it is necessary to refer back to the definition and the phrase "with no holds occurring that would cause a mission abort." Many countdown events/functions can fail and be repaired without causing a mission abort, which introduces a fourth major factor, maintainability. The countdown reliability measurement program does not attempt to evaluate maintainability. Therefore, countdown reliability in accordance with the definition is significantly higher than the countdown reliability being measured.

Measurements of countdown reliability are based on techniques in IR-64-14 and include design and achieved reliability measurements. Revisions to this plan have been made in this report. The latter refer to the three major factors: hardware, procedure, and personnel. The former refer only to the design aspect of the hardware factor. The countdown-achieved evaluation has been updated to include pertinent data affecting this measurement that was not available for inclusion in last quarter's report.

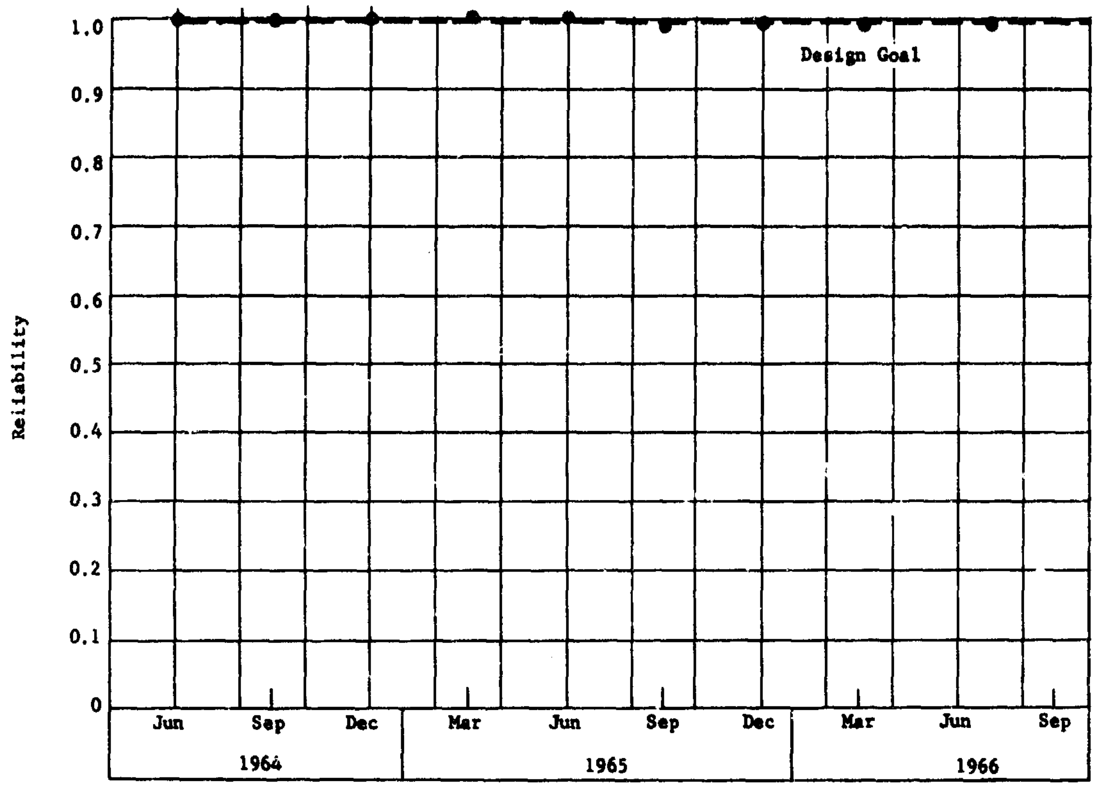

Fig. 4 MDS Design Reliability Estimate, Primary Function

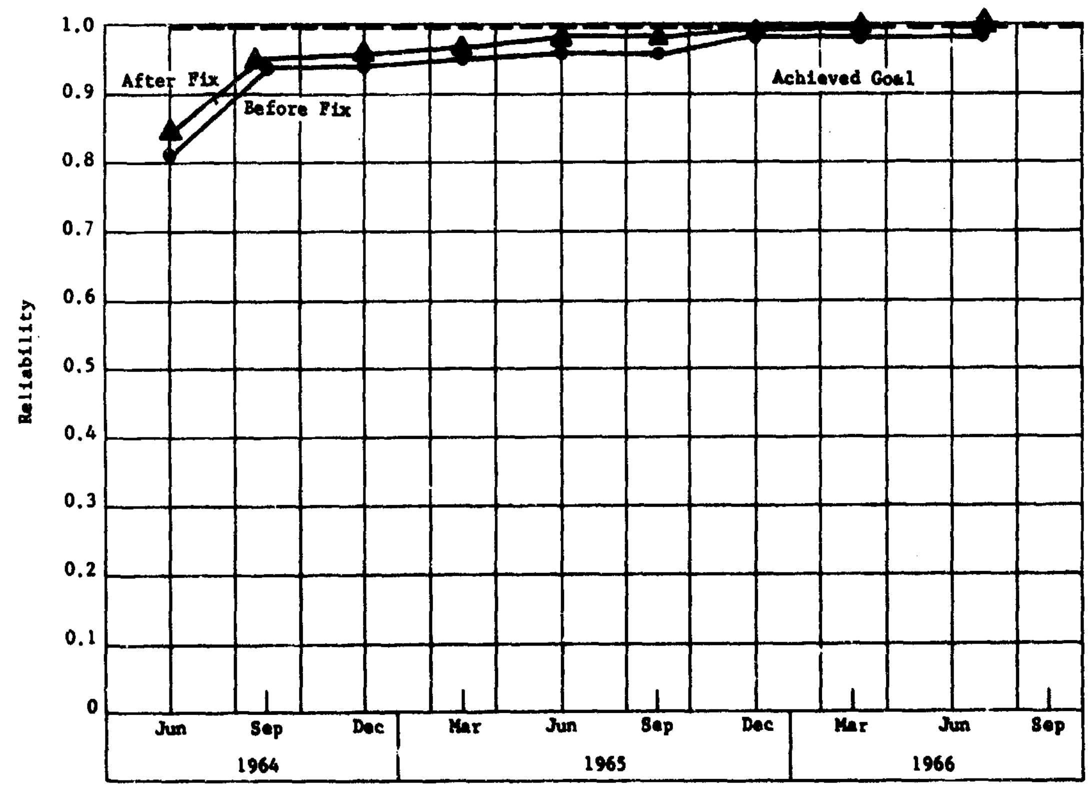

Fig. 5 MDS Achieved Reliability Estimate, Primary Function

Table 3 Problem Summary, Flight Reliability Measurement (Performance Criteria) for Martin Portion of Titan III (Configuration C)

SSLV	Failure Date	Problem Description	Problem Class	Corrective Action	Problem Status*	Document Reference
2	9-1-64	Pressurization of transtage oxidizer tank failed after 189 sec of operation.	Design	See Table 13.	Closed, Class 2 6-30-66	Flight Test Report EDCS-3417 EDCS-3634 EDCS-2996
8	12/21/65	Transtage attitude control system failed during the second transtage coast. The oxidizer valve in pitch 5 engine module, P/N PD60S0147-069, leaked excessively, thus depleting oxidizer supply prematurely.	Design	Analysis of data obtained indicates failure of the ACS was caused by contamination. Several procedural changes have been initiated to prevent or minimize contamination in the ACS. Also, EDCS 4912, effective on Articles 5, 9, and up, was released which states that dummy ACS engines will be used for build and test at the Martin facility in Denver and will be replaced with flyable ACS engines at ETR. EDCS 4936 (Supplement A, B, C, and D) was released which stipulates the preacceptance criteria to be used for ACS rocket engine modules (REM) and stipulates special tests to be conducted to evaluate possible failure modes of the propellant valves. Case history of the REMs will be maintained and evaluated as data becomes available.	Closed, Class 1	

*Closed denotes corrective action has been taken and problem is considered closed.
Class 1 denotes that the corrective action (fix) is not verified.
Class 2 denotes that the corrective action (fix) was verified.

Table 4 MDS Problem Summary

Subsystem	Failure Date	Problem	Classification	Corrective Action	Problem Status†	Reference Report
Pressure Switch PD7180069	3-4-64	Contact chatter during DAT shock tests. Cause unknown.	P	Cause of failure not confirmed. Subsequent DAT shock test successful.	Closed, Class 2 5-30-64	Env Lab Report 721 45-01
	5-25-64	Pressure transfer tests failed during DAT vibration. Test band radius was too short.	P	Personnel cautioned to exercise more care during assembly. Effective 5-30-64.	Closed, Class 2 5-30-64	Env Lab Report 72187
Rate Gyro System 80801D30000	3-23-64	No SMRD output during DAT bench operation because of short circuit caused by operator.	P	Jumper wires will not be used on the Genesco tablotop, as the grounding capability required has been incorporated to the test tool. Effective 3-23-64.	Closed, Class 2 3-28-64	Env Lab Report 1902-2
	4-23-64	Distorted 800 ~ output during subsystem tests caused by overload applied during module tests.	P	Tooling redesigned. Effective 5-8-64.	Closed, Class 2 5-13-64	MARS A19945 A46645 A46821
	4-25-64	Low yaw output during subsystem tests because ground loop in test tool overloaded yaw torquers and produced a short.	P	Test tools are now verified by Quality. Effective 4-28-64.	Closed, Class 2 5-2-64	MARS A19969 A41962
	6-14-64	VECOS no-go caused by shorted 26 V 800 cps input in gyro package. Believed to have been caused by excessive overload during module tests.	P	Problem has not occurred in subsequent tests.	Closed Class 2 9-30-65	MARS A20427 A29741
	6-19-64	Spurious signals by yaw rate gyro during CST, caused by defective capacitor. Analysis revealed apparent overcurrent on capacitor. Reason unknown.	P	EDCS 2917-002 introduced additional controls on capacitor effective 12-1-64.	Closed Class 2 9-30-65	MARS A20447
	7-16-64	No SMRD output with gyro spin motors rotating caused by shorted roll gyro start capacitor attributed to faulty workmanship.	P	EDCS 2917-002 introduced additional controls on capacitor effective 12-1-64.	Closed Class 2 9-30-65	MARS A44771 A45095
	7-30-64	Short in primary winding at crossover point in the RGS power transformer. Specific cause undetermined.	P	Mylar tape is now used to secure windings at crossover point. Effective 8-7-64.	Closed, Class 2 8-28-64	MARS A43554 A45078 A45077 A45079
	8-19-64	No MDS RGS output due to broken C145A22 wire at USAA1P1-X connector.	P	Personnel cautioned to exercise more care when engaging connectors.	Closed, Class 2 9-25-64	MARS A43658
Malfunction Detection Programer Set 80801U01000	5-22-64	MDS engine shu[illegible]wn signal not present during DAT post vibration functional test. Analysis revealed a capacitor installed with polarity reversed.	P	More stringent inspection of assemblies now required. Effective 5-25-64.	Closed, Class 2 6-11-64	Env Lab Report 1919-10
	6-3-64	Cracked diode caused DAT performance test failure. Analysis revealed apparent rough handling of module assembly.	P	Handling and inspection procedures were changed to impose better control. Effective 6-4-64.	Closed, Class 2 6-18-64	Env Lab Report 1919-81
	6-8-64	Erratic output during DAT vibration test caused by improperly soldered PC board.	P	Soldering instructions were made more explicit and QC buy-off added prior to installation in MDP. Effective 6-8-64.	Closed, Class 2 6-15-64	Env Lab Report 1919-12
	6-9-64	Static inverter output dropped out during DAT vibration test. Analysis revealed wire not installed per specification.	P	Personnel cautioned and shop sketches revised to add more detailed installation instructions. Effective 6-19-64.	Closed, Class 2 6-26-64	Env Lab Report 1919-13

*P denotes practice failure, D denotes design failure.

†Closed denotes corrective action has been taken and problem is considered closed.
Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified.
Open denotes problem is considered open with no known corrective action initiated.

In this quarterly report, measurement of the Martin portion of the Titan III for a Configuration C countdown are included in Figures 6 and 7. Measurements for individual subsystems are included in Tables 5 and 6. Qualitative descriptions of problems and subsequent fixes affecting this measurement are broken down into airborne equipment problems, Table 7, and aerospace ground equipment problems, Table 8.

D. FLIGHT RELIABILITY PREDICTIONS

The preceding measurements indicate the reliability of the Martin portion of the Titan III as of 31 March 1966. The flight reliability prediction is intended to show, as of then, what the reliability of the Martin portion of Titan III will be at the end of the R&D program. The prediction technique is included in the appendix. Flight reliability predictions are presented in the following figures:

1) Design Reliability Prediction for Martin Portion of Titan III (Configuration A) during Flight, Fig. 8;
2) Achieved Reliability Prediction for Martin Portion of Titan III (Configuration A) during Flight, Fig. 9;
3) Design Reliability Prediction for Martin Portion of Titan III (Configuration C) during Flight, Fig. 10;
4) Achieved Reliability Prediction for Martin Portion of Titan III (Configuration C) during Flight, Fig. 11.

Reliability predictions for individual subsystems are also included in summary tables (9, 10, 11, and 12) below each of the figures. Qualitative descriptions of problems and subsequent fixes affecting these predictions are included in Table 13.

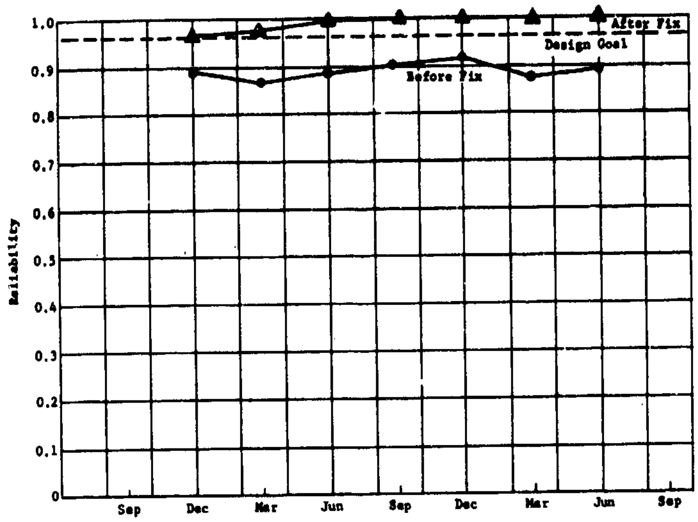

Fig. 6 Design Countdown Reliability Measurement for Martin Portion of Titan III (Configuration C)

Table 5 Subsystem Breakdown, Martin Portion of Titan III (Configuration C), Countdown Design Reliability

System	Countdown Phase				
	T-195 thru T-45 min	T-45 thru T-35 min	T-35 min thru T-32 sec	T-32 sec thru T-0	Total
Airborne Subsystems					
Electrical	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	0.99537 / 1.0	0.99537 / 1.0
Propellant and Pressurization	0.98113 / 1.0	*	1.0 / 1.0	1.0 / 1.0	0.98113 / 1.0
Flight Controls	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Ordnance	1.0 / 1.0	*	*	*	1.0 / 1.0
Malfunction Detection System	1.0 / 1.0	1.C / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Tracking and Flight Safety	1.0 / 1.0	*	0.99490 /1.0	1.0 / 1.0	0.99490 / 1.0
Attitude Control System	1.0 / 1.0	*	1.0 / 1.0	0.99435 / 1.0	0.99435 / 1.0
Airborne Total	0.98113 / 1.0	1.0 /1.0	0.99490 /1.0	0.98975 / 1.0	0.96612 / 1.0
Aerospace Ground Equipment					
Control Monitor Group	1.0 / 1.0	1.0 / 1.0	0.99487/1.0	0.97935 / 0.98974	0.97433 / 0.98974
Van Power Distribution Control	1.0 / 1.0	1.0 / 1.0	1.0 /1.0	0.99537 / 1.0	0.99537 / 1.0
Launch Pad Power Distribution Control	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Control Center Power Distribution Control	1.0 / 1.0	*	*	*	1.0 / 1.0
Launch Control Console	1.0 / 1.0	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Tracking and Flight Safety Control Panel	*	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Data Transmission Set	1.0 / 1.0	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
RF Transmission	1.0 / 1.0	*	1.0 / 1.0	*	1.0 / 1.0
Vehicle Checkout Set	*	0.98914 / 1.0	*	1.0 / 1.0	0.98914 / 1.0
Propellant Transfer and Pressurization	1.0 / 1.0	*	*	*	1.0 / 1.0
Tracking and Flight Safety Checkout Set	1.0 / 1.0	*	0.99441/1.0	0.98947 / 1.0	0.98394 / 1.0
Power Supply 1	1.0 / 1.0	*	*	*	1.0 / 1.0
Power Supply 2	1.0 / 1.0	*	*	*	1.0 / 1.0
Air Conditioning	1.0 / 1.0	*	*	*	1.0 / 1.0
Pad Water	*	*	*	1.0 / 1.0	1.0 / 1.0
Launch and Support Equipment	*	*	1.0 / 1.0	*	1.0 / 1.0
Interconnections	1.0 / 1.0	1.0 / 1.0	0.98361/1.0	1.0 / 1.0	0.98361 / 1.0
Aerospace Ground Equipment Total	1.0 / 1.0	0.98914 / 1.0	0.97310/ 1.0	0.96456 / 0.98974	0.92842 / 0.98974
System Total	0.98113 / 1.0	0.98914 / 1.0	0.96814/ 1.0	0.95467 / 0.98974	0.89697 / 0.98974

*Indicates those systems that do not actively participate in (or are not interrogated during) that portion of the sequence.
Before Fix = xxxxxx / xxxxxx = After Fix

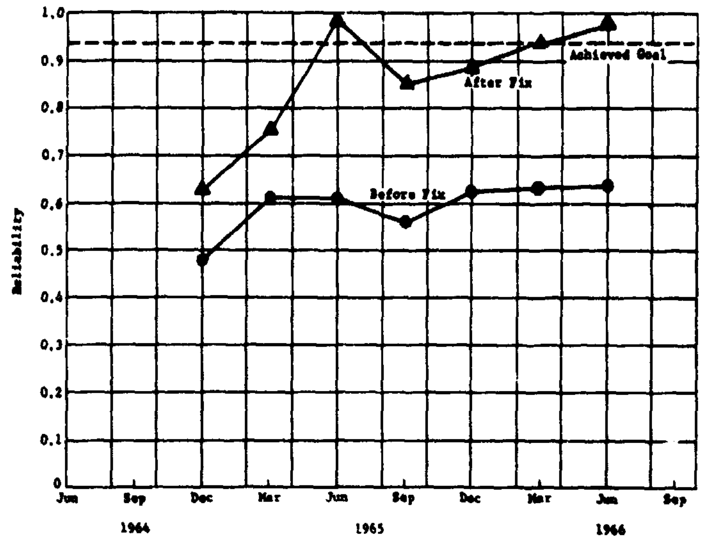

Fig. 7 Achieved Countdown Reliability Measurement for Martin Portion of Titan III (Configuration C)

Table 6 Subsystem Breakdown, Martin Portion of Titan III (Configuration C), Countdown Achieved Reliability

System	Countdown Phase				
	T - 195 thru T - 45 min	T - 45 thru T - 35 min	T - 35 min thru T - 32 sec	T - 32 sec thru T - 0	Total
Airborne Subsystems					
Electrical	0.99429 / 1.0	0.99457 / 1.0	1.0 / 1.0	0.99537 / 1.0	0.98431 / 1.0
Propellant and Pressurization	0.98113 / 1.0	*	1.0 / 1.0	0.99435 / 1.0	0.97559 / 1.0
Flight Controls	1.0 / 1.0	0.98427 / 1.0	0.99490 / 1.0	1.0 / 1.0	0.97925 / 1.0
Ordnance	1.0 / 1.0	*	*	*	1.0 / 1.0
Malfunction Detection System	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Tracking and Flight Safety	1.0 / 1.0	*	0.99490 / 1.0	1.0 / 1.0	0.99490 / 1.0
Attitude Control System	1.0 / 1.0	*	1.0 / 1.0	0.99435 / 1.0	0.99435 / 1.0
Airborne Total	0.97553 / 1.0	0.97893 / 1.0	0.98983 / 1.0	0.98416 / 1.0	0.93029 / 1.0
Aerospace Ground Equipment Systems					
Control Monitor Group	0.97279 / 1.0	1.0 / 1.0	0.97949 / 1.0	0.91227 / 0.98469	0.86825 / 0.98440
Van Power Distribution Control	1.0 / 1.0	0.96429 / 1.0	0.98972 / 1.0	0.99537 / 1.0	0.94994 / 1.0
Launch Pad Power Distribution Control	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Control Center Power Distribution Control	1.0 / 1.0	*	*	*	1.0 / 1.0
Launch Control Console	1.0 / 1.0	*	1.0 / 1.0	0.99539 / 1.0	0.99539 / 1.0
Tracking and Flight Safety Control Panel	*	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
Data Transmission Set	1.0 / 1.0	*	1.0 / 1.0	1.0 / 1.0	1.0 / 1.0
RF Transmission	1.0 / 1.0	*	1.0 / 1.0	*	1.0 / 1.0
Vehicle Checkout Set	*	0.90723 / 1.0	*	1.0 / 1.0	0.90723 / 1.0
Propellant Transfer and Pressurization	1.0 / 1.0	*	*	*	1.0 / 1.0
Tracking and Flight Safety Checkout Set	0.99492 / 1.0	*	0.97312 / 1.0	0.98437 / 1.0	0.95305 / 1.0
Power Supply 1	1.0 / 1.0	*	1.0 / 1.0	*	1.0 / 1.0
Power Supply 2	1.0 / 1.0	*	1.0 / 1.0	*	1.0 / 1.0
Air Conditioning	1.0 / 1.0	*	1.0 / 1.0	*	1.0 / 1.0
Pad Water	*	*	*	1.0 / 1.0	1.0 / 1.0
Launch Support Equipment	*	*	1.0 / 1.0	*	1.0 / 1.0
Interconnections	1.0 / 1.0	0.98341 / 1.0	1.0 / 1.0	0.98434 / 1.0	0.96830 / 1.0
Aerospace Ground Equipment Total	0.94783 / 1.0	0.86852 / 1.0	0.94334 / 1.0	0.87307 / 0.98469	[illegible] / 0.98440
System Total	0.94417 / 1.0	0.84239 / 1.0	0.93377 / 1.0	[illegible] / 0.98469	[illegible] / 0.98440

*Indicates those systems that do not actively participate in (or are not interrogated during) that portion of the sequence.
Before Fix = xxxxxx / xxxxxx = After Fix

Table 7 Summary of Countdown Problems, Titan IIIC Airborne Equipment

Subsystem	Titan III	Failure Date	Problem Description	Class Phase*	Corrective Action	Problem Status	Reference Report
Malfunction Detection System	2	6-18-64	Spurious abort signals from rate gyro due to defective C-4 capacitor, P/N 90890-1, in assembly 80801D30400.	P/2	Rate gyro replaced and satisfactory operation obtained. Vendor manufacturing error. EDCS 2917-002 introduced additional controls on capacitor, effective 12-1-64.	Closed, Class 2 6-30-65	MARS A20447
Electrical	2	8-28-64	Spurious underpressure signal caused by moisture in connector (due to Hurricane Cleo).	P/1	Dried out moisture in connector and satisfactory operation obtained. EDCS M03971 issued on A/B connector mating inspection to preclude connector discrepancies such as bent pins or contamination and damaged shells. Effective Articles 4, 5 and 8 thru 17. This was also implemented at ETR by issuance of Test Procedure GM03-1B, Articles 4, 5, 6, 7 and 8 thru 17.	Closed, Class 2 6-30-65	MARS X05713
	4	4-22-65	Did not obtain APS Power Switch Closed indication; caused by power transfer time being exceeded by motor-driven switch because of flow of nylon brush holder.	D/4	Motor-driven switch redesigned to -503 per M03772-001, effective Articles 4, 5, and 8 thru 17 with retrofit on Articles 6 and 7.	Closed, Class 2 9-1-65	SFAR P4-0391 MARS A44333
	VTF	12-64	Hold occurred at VECOS frame 5 because two connectors between ACS nozzle diode packages were reversed. The connectors were physically damaged by mismatching.	P/2	Responsible personnel were cautioned to exercise more care when mating connectors.	Closed, Class 2 6-10-64	SFAR P6-0094
Flight Controls and Hydraulics	2	6-18-64	Momentary Stage I hydraulic pressure No-Go was obtained	P/2	Recycled and operation was satisfactory. Hydraulic fluid warmed up to preclude this problem from reoccurring. Also, P4 Ground Hydraulic System Installation Dwg VTF 340700 was changed, which decreases hydraulic fluid leakage.	Closed, Class 2 6-30-65	Official copy of GD01-P4
	1	8-13-64	Stage I hydraulic reservoir level switch burned; caused by J-box cover blowing into J-box resulting in short	P/2	Personnel cautioned. Reservoir replaced and satisfactory operation obtained.	Closed, Class 2 6-30-65	SFAR D1-0136 MARS B53437
	1	7-4-64	Did not obtain response from A/P sensor outputs; caused by pinched wire in Flight Control Computer resulting in short to case.	P-2	EDCS M02573 provides wire protection, effective Articles 1 and 3 thru 17.	Closed, Class 2 6-30-65	SFAR D1-0062 MARS B10606
	8	9-12-65	Stage I Hydraulic operation inadequate caused by improper Stage I reservoir ([illegible]) setting.	P/3	Stock was purged and all reservoirs having improper setting were returned to vendor.	Closed, Class 2 1-1-66	MARS M03674, M03688

*Class denotes failure classification: P, practice; D, design. Phase refers to countdown phase: 1 = T - 195 to T - 45 min; 2 = T - 45 to T minus 35 min; 3 = T - 35 min to T - 32 sec; and 4 = T - 32 to T - 0 sec.

†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Table 7 (concl)

Subsystem	Titan III	Failure Date	Problem Description	Class Phase*	Corrective Action	Problem Status†	Reference Report
Attitude Control System	2	8-31-64	Loss of "Att. Con. Fuel and Ox. Tks below ULL" signal; caused by failure of primary regulator P/N NAS-28120T2-1 and S/N 119 and secondary regulator P/N NAS-28120T2 and S/N 117.	D/4	Analysis revealed ACS regulator ball material (tungsten carbide with cobalt binder) was incompatible with N_2O_4 vapors. EDCS M03763 changes ball material to K601, effective Articles 4, 6, and 8 thru 17 with retrofit on Article 7. During DAT of PD6080147-089, using K601 material, test specimens S/N 110 and 111 successfully performed approximately 200 operating cycles during performance vibration and propellant compatibility. (N_2O_4 vapors and H_2O vapors were applied simultaneously on S/N 111.)	Closed, Class 2 6-30-65	
Propellant Transfer and Pressurization	3	2-11-65	Stage III Fuel Tank overpressurized; caused by failure of Stage III fuel checkout switch to function at 91 psi (Note: Even though a hold was obtained, this failure did not cause a countdown delay).	D/1	EDCS M03634 installs relay and diode suppression circuitry in Stage III propellant pressurization system, effective Articles 4, 5, and 8 thru 17 with retrofit on Article 6. During countdown of Article 6, no problem was encountered in Stage III propellant pressurization system. Two pressure switch cells were tested independently on 25 and 26 February 1965 in the Martin-Denver Cold Flow Lab. During these tests each cell operated successfully 27,500 cycles at 6 cps and 2500 cycles at 2 cps. (During normal launch countdown, the total cycle of the Stage III pressure switch would normally be less than 200 cycles.) Also, a total of over 29 Stage III single control redundant pressurization system tests were conducted successfully at the Cold Flow Lab between 3-26-65 and 6-30-65. (Each of these tests simulated a Stage III propellant pressurization system operation during launch countdown and flight).	Closed, Class 2 6-30-65	
	7	6-16-65	Lost "Stg 2 Ox Tnk below ULL Maintained" signal; caused by improper loading of Stage II Oxidizer tank due to misadjusted ground pressure relief valve as revealed by failure analysis.	P/1	P-41 facility checked and all stock purged for this discrepancy. Test procedure 8A30 changed to check for this condition prior to propellant loading.	Closed, Class 2 3-31-66	
	7	6-16-65	Lost "Stg 2 Ox Tnk below ULL Maintained" signal; caused by improper loading of Stage II Oxidizer tank due to misadjusted ground pressure relief valve as revealed by failure analysis.	P/4	P-41 facility checked and all stock purged for this discrepancy. Test procedure 8A30 changed to check for this condition prior to propellant loading.	Closed, Class 2 3-31-66	
Tracking and Flight Safety	8	9-24-65	Sensitivity; low on pulse beacon (PD6480377-029, S/N 22).	D/3	Pulse beacon replaced and satisfactory operation obtained. Configuration -029 replaced by -049 configuration having hi-rel diodes in mixer assembly.	Closed, Class 2 1-1-66	MARS ZA9005

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†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Table 8 Summary of Countdown Problems, Titan IIIC Aerospace Ground Equipment

Subsystem	Location	Failure Date	Problem	Class Phase*	Corrective Action	Problem Status†	Reference Report
Launch Control Console	VTF	10-22-64	Fire engine indication, CMG to LCC, was not obtained; caused because engine shutdown reset switch on LCC was in shutdown position instead of reset position.	P/3	Engine shutdown reset switch was positioned to reset. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR P4-0276
Launch Control Console	P-20	12-10-64	Obtained "CORE HOLD" at T-31 sec; caused by LCC operator not pushing "INITIATE LAUNCH" button prior to T-31 sec.	P/4	Procedure changed which cautions LCC operator to push "INITIATE LAUNCH" button prior to T-31 sec.	Closed, Class 2 6-30-65	
Control Monitor Group	VTF	6-11-64	"TANKS PRESSURIZED" signal was not obtained; caused by overcurrent condition resulting in failure of diodes.	P/1	Defective diodes replaced and satisfactory operation obtained.	Closed, Class 2 6-30-65	MARS A-20419
	VTF	9-15-64	"TANKS PRESSURIZED" signal was not obtained; caused by patch board not being properly installed.	P/1	Patch board properly installed and satisfactory operation obtained. Personnel instructed to be more cautious while installing patch boards.	Closed, Class 2 6-30-65	SFAR P4-240
	VTF	7-26-64	"TANKS PRESSURIZED" signal was not obtained; caused by excessive current applied to Q2 transistor due to short or overload output.	P/1	PC board replaced and satisfactory operation obtained. Failure analysis of board was inconclusive.	Closed, Class 2 6-30-65	SFAR P4-0194 MARS A44730 and A61828
	D-1	11-13-64	Did not obtain "LAUNCH SEQUENCE STARTED" indication, CMG to LCC; caused by pushed back pin in CMG board P/N 80801FL1299-009.	P/4	Personnel instructed to be more cautious while installing PC boards.	Closed, Class 2 6-30-65	SFAR D1-0209 MARS A47483
	VTF	6-18-64	"CMG GO", CMG to range, signal not obtained; caused by defective CMG PC Board P/N 80801FL2293.	P/3	Defective PC Board replaced and satisfactory operation obtained.	Closed, Class 2 6-30-65	SFAR P4-0141 MARS A-44449
	P-20	8-19-64	"LAUNCH SEQUENCE STARTED" indication, CMG to LCC, was not obtained; caused by H_2O pressure marginal due to insufficient pressure in K bottle (simulating closed switch with H_2O off).	P/4	This hold monitor was patched out of the CMG per W03127-002. Effective on all articles.	Closed, Class 2 6-30-65	
	VTF	7-27-64	"INITIATE C/D STEERING CK." (off), CMG to IGS, did not occur; caused by patching error in CMG.	P/4	Personnel cautioned to adhere to wiring procedures.	Closed, Class 2 6-30-65	SFAR P4-0195
	VTF	9-24-64	"DESTRUCT ARM SIGNAL," CMG to TAFS, was not obtained; caused by inadequate time patching in CMG to obtain Stage 1 engine null response.	D/4	Time patching in Success Criteria 8090008105, Rev. H, issued 8-27-64 and implemented per WD2879-001.	Closed, Class 2 6-30-65	SFAR P4-260

*Class denotes failure classification: P, practice; D, design. Phase refers to countdown phase: 1 = T - 195 to T - 45 min; 2 = T - 45 to T minus 35 min; 3 = T - 35 min to T - 32 sec; and 4 = T - 32 to T - 0 sec.
†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Table 8 (cont)

Subsystem	Location	Failure Date	Problem	Class./ Phase*	Corrective Action	Problem Status†	Reference Report
Control Monitor Group	D-1	7-30-64	"ADVANCE TO INERTIAL" signal, CMG to IGS, was not obtained; caused by broken patch cord.	P/4	Patch cord replaced and proper operation obtained.	Closed, Class 2 6-30-65	SFAR D1-0104
	D-1	7-2-64	Obtained a hold during terminal count while CMG was sending RCCW/YR land excitation signal to vehicle; caused by wiring error resulting in constant 28 V at TB2020-145. M01654 had not been worked preceding start of test.	P/4	M01654 incorporated per L/C D1-3602.	Closed, Class 2 6-30-65	SFAR D1-0055
	P-20	8-11-64	"STAGE I ENGINE START" signal, CMG to VPDC, was not obtained; caused by wire from CMG misterminated.	P/4	Wire properly terminated and verified. Personnel cautioned.	Closed, Class 2 6-30-65	MARS X14361
	VTF	5-11-64	Did not receive SRM 1 and 2 "POWER TRANSFERRED" indication VPDC to CMG; caused by improperly mated PC board connection.	P/4	Connectors mated properly and operation verified. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR P4-0090
	VTF	5-12-64	Did not obtain "OPEN TVC INJECTANT PREVALVE" signal, CMG to VPDC; caused by defective 150 ma power switch in PC board resulting from short to ground on output terminal.	P/4	PC board replaced and satisfactory operation obtained. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR P4-0095 MARS A44437
	P-40	6-13-65	Obtained "CMG Hold"; operator had not reset CMG and reapplied "B" power.	P/1	Personnel cautioned to adhere to test procedure.	Closed, Class 2 3-31-66	
	P-40	8-25-65	Core HOLD obtained at T-9.8 sec; caused by mistermination in CMG patch	P/4	CMG patch properly terminated and personnel cautioned	Closed, Class 2 3-31-66	MARS X58177
	P-40	8-25-65	CMG Minute Counter disabled; caused by loose patch wire at back of FL 2023 patch board	P/1	CMG patch board wire properly terminated and personnel cautioned	Closed, Class 2 3-31-66	MARS X55301
	VIB	9-10-65	CMG did not advance beyond T-2 hr 52 min.	D/3	Engineering DCNR initiated 12/13/65 to PD drawing (change R). This DCNR changed the pin design configuration.	Closed, Class 2 1-1-66	MARS X37962 FAR-CT-469
	VIB	9-13-65	Wire No. 1283 on FW 20-PB1:33 was terminated improperly.	P/4	Personnel cautioned; wire properly terminated and verified.	Closed, Class 2 1-1-66	MARS X38702
	P-41	11-17-65	Obtained HOLD at T-1 sec; caused by incorrect engineering patching of EVENTS LEVEL.	D/4	Engineering corrected patching error; EVENTS LEVEL properly patched and verified.	Closed, Class 2 1-1-66	MARS X40451
	VIB	12-6-65	Obtained HOLD at T-14 sec; caused by CR-1 zener diode failure in baby board A5 of printed circuit board 80801FL2257-009.	D/4	Failure was verified but failure analysis is inconclusive as to positive cause of failure. Failure mode will be monitored for reoccurrence.	Open	MARS X74094 FAR-CT-549
	VIB	5-11-66	HOLD obtained at T-10 sec because VECOS did not turn on at T-19 sec; caused by patching error in CMG patch board P/N 80801FL1023.	D/4	Patch Z7-AA7 corrected to Z7-EE7 by issuance of Change G to Success Criteria, 80800000H105.	Closed, Class 1	MARS X75641 MARS X75642
	VIB	5-11-66	At T-14 sec, LOCK-OUT SVD MONITOR signal not received; caused by mispatch in CMG patch board P/N 80801FL1023.	P/4	Patch error corrected. Personnel cautioned.	Closed, Class 1	MARS X75643
Van Power Distribution Control	D-1	9-16-64	Did not obtain "POWER GO" signal, VPDC to CMG; caused by CR-17 diode open in 80801EA1300 VPDC rack resulting in absence of CMG interlock. This test was the first one that adequately verified circuitry of this VPDC rack.	P/3	CR-17 diode replaced and test rerun successfully.	Closed, Class 2 6-30-65	SFAR D1-0171
	P-20	8-11-64	Did not obtain "FIRING LINE RELAY ARMED" signal in VPDC; caused by loose screws in PC board.	P/3	Loose screws tightened and test was rerun successfully.	Closed, Class 2 6-30-65	MARS X14597
	VTF	5-11-64	Did not obtain power transferred signal, VPDC to CMG; caused by time patching error.	D/4	Success Criteria 80800000H105 revised to correct time patching for Article 1.	Closed, Class 2 6-30-65	SFAR P4-0091

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†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Table 8 (cont)

Subsystem	Location	Failure Date	Problem	Class./ Phase*	Corrective Action	Problem Status†	Reference Report
Vehicle Checkout Set	D-1	6-26-64	Did not obtain ready to read signal at completion of "APPLY VEHICLE POWER" VECOS test frame. The rack configuration was not per print.	P/2	MOD M01823-002 and 003 was incorporated per D&WA 11554. Subsequent retests were successful. Effective 6-26-64.	Closed, Class 2 7-2-64	SFAR D1-039
	VTF	6-13-64	Did not obtain ready to read signal at completion of "GYRO HEATER" VECOS test frame. The 500-msec time delay PC board, P/N 80801FB1477-019 (A4A3A6) was timing out prematurely.	P/2	The defective time delay PC board was replaced and the retest was successful.	Closed, Class 2 6-30-64	SFAR P4-155 MARS A20432
	VTF	6-18-64	Did not obtain ready to read signal at completion of "ROLL CCW ATTITUDE" test of A/P coast output VECOS test frame. Malfunction was isolated to C-4 capacitor. The cause unknown as the yaw capacitor was damaged during failure analysis.	P/2	Yaw rate gyro was replaced and the retest was successful. EDCS 2917-002 introduced additional controls on capacitor. Effective 12-1-64.	Closed, Class 2 12-16-64	SFAR P4-146
	VTF	5-10-64	PU/YR stimulus from VECOS to Stage II rate gyro was not obtained due to an apparently defective K-1 relay in the 80801FB1291-009 PC board. The reported failure could not be verified during failure analysis. It is believed that overcurrent in stimulus circuitry induced contact skip in the relay.	I/2	Lockup of stimulus generator is now prevented per EDCS 5146-327 (M02253). Effective 6-11-64.	Closed, Class 2 8-2-64	SFAR P4-087 MARS A44577
	VTF	6-15-64	Did not obtain ready to read signal at completion of "STAGE II HYDRAULICS CHECK" VECOS test frame. Analysis revealed patching inadequate for Stage II actuator responses.	D/2	Time patching corrected per M02527. Effective 11-1-64.	Closed, Class 2 12-16-64	SFAR P4-154, P4-155
	VTF	6-15-64	The "Stage I FUEL LOW LEVEL SENSOR" signal from the vehicle to the VECOS was not obtained due to defective 80801FB1389-009 PC board.	D/2	Patching circuit boards A3A5 and A3A6 were interchanged and operated properly.	Closed, Class 2 7-17-64	SFAR P4-135 MARS A20430
	D-1	6-28-64	Did not obtain ready to read signal at completion of "MDS NULL" VECOS test frame. Analysis revealed improper sequence in the procedure.	P/2	Test procedure was corrected. Effective Article 1.	Closed, Class 2 8-1-64	SFAR D1-042

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†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Table 8 (concl)

Subsystem	Location	Failure Date	Problem	Class./Phase*	Corrective Action	Problem Status†	Reference Report
Vehicle Checkout Set	VTF	5-12-64	PU/YR attitude stimulus from VECOS to A/P was not obtained due to reversed connectors to the ACS nozzle diode package.	P/2	Personnel cautioned to use more care in mating connectors.	Closed, Class 2 6-30-65	SFAR P4-094 A44609 and A44011
	VTF	10-29-65	Absence of TCPS monitor signal caused hold at VECOS frame 3. Plug one was not properly connected	P/2	Plug connected and the responsible personnel were cautioned	Closed, Class 2 11-5-65	Official Test Procedure
	VIB	9/24/65	Obtained NO-GO on frames 46 and 47 and found CR-1 zener diodes shorted in A6 relay module in printed circuit board 80801FB1291-009; caused by contamination in potting compounds used between relay coil and terminal 2.	P/2	Printed circuit board was replaced and satisfactory operation obtained. Failure mode was monitored with no repetition of failure noted.	Closed, Class 2 3-30-66	MARS X53211
	VIB	9/24/65	Obtained NO-GO on frames 99 and 101; caused by improper configuration.	P/2	Personnel cautioned to establish proper vehicle configuration after trouble-shooting.	Closed, Class 2 6-30-66	MARS X38725
	P-4	12/15/65	A defective printed circuit board caused a NO-GO in frame 1 (VECOS) because output from OR gate A4A4A7 had no input.	P/2	Board was removed and the failure could not be duplicated in test.	Closed, Class 2 6-30-66	SFAR P4-602 MARS A22363
Tracking and Flight Safety	VTF	7-27-64	Did not obtain T&FS signal, T&FS to CMG; caused by wire mistermination resulting in no output from T&FS switch TACA2D515	P/3	Wire from NACA1A9A4 to JACA2D815 terminated properly. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR P4-0200
	P-20	8-19-64	Did not receive launch sequence started indication; caused by command control receivers not beirg reset.	P/3	Command control receivers reset. PCN issued to procedure and all operator personnel alerted.	Closed, Class 2 6-30-65	
	D-1	7-2-64	Did not obtain "DESTRUCT ARM" signal, T&FS to VPDC; caused by patching error on timing level 99.	D/4	ETO revised to correct patching.	Closed, Class 2 6-30-65	SFAR D1-0056
	D-1	7-1-64	Did not obtain T&FS power switch transfer to A/B power signal, T&FS to vehicle; caused by J-15 connector being disconnected.	P/4	J-15 connector mated. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR D1-0039
	P-41	12-6-65	DRS channel 413 cycled on and off (SRM 1 and 2 IGNITER SAFE SIGNAL); caused by low voltage (less than 15 vdc) on tracking and flight safety CMG printed circuit board, 80801JAC183-009, resulting from cracked diode caused by improper handling.	P/4	Personnel were cautioned to exercise handling care. This diode is very susceptable to damage, since it is a miniature glass diode having heavy leads for high current.	Closed, Class 2 6-30-66	MARS X74073
Electrical Interconnections	VTF	9-18-64	Simulated Stage II fuel prevalve open signal, Vehicle to CMG was not obtained; caused by 2D43 CMG connector not being properly mated.	P/4	Connector mated properly. Personnel cautioned.	Closed, Class 2 6-30-65	SFAR P4-0241 Add. 1
	P-40	8-25-65	Obtained VECOS indication of 44 mv stimulus in NULL test frames; caused by computer plug D 3AA2-P5 disconnected	P/2	Computer plug properly connected and personnel cautioned	Closed, Class 2 3-31-66	MARS X56484
	P-40	8-25-65	Obtained No-Go in SRM/Gain State 3 test frame; caused by discontinuity in Transporter Cabling Set	P/2	Transporter Cabling Set repaired and continuity established	Closed, Class 2 3-31-66	MARS X51550
	VTF	8-6-65	Lost 'Stage III Oxid Tank Press. Cont." signal; attributed to faulty connector B1LA06-P3-6	D/3	Cable assembly redesigned and potting material changed on EDCS's WO 3470 & WO 4228.	Closed, Class 2 8-17-65	MARS A2867[illegible] SFAR P4-30[illegible]
	VIB	9/10/65	Obtained NO-GO on frame 30; caused by wire mistermination to VECOS.	P/2	Personnel cautioned. Wire properly terminated and verified.	Closed, Class 2 1-1-66	MARS X49048
	VIB	9/10/65	Obtained NO-GO on frames 207, 209, 211, 215, 217, 221, 223, and 225; caused by contamination in 8-21 J-box.	P/2	J-box cleaned and proper operation obtained. Personnel cautioned.	Closed Class 2 6-30-66	MARS X38485 and X37961
	VTF	3-29-66	During CST, the T&FS GO failed to appear due to faulty connector pins.	P/4	Connector was replaced and personnel cautioned to be more careful when troubleshooting.	Closed 1 Class 2 5-13-66	MARS A22835 MARS A67336 MARS A67379

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†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

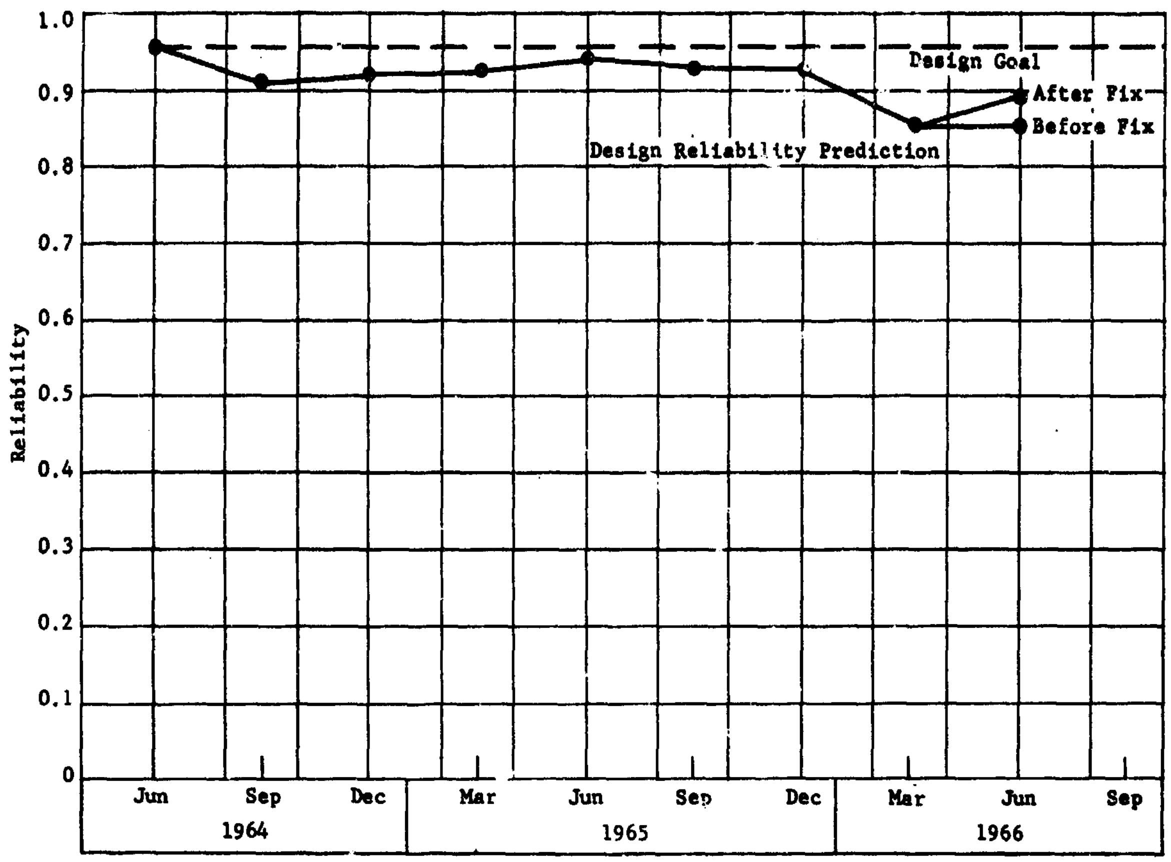

Fig. 8 Design Reliability Prediction for Martin Portion of Titan III (Configuration A) during Flight

Table 9 Design Reliability Predictions for Individual Subsystems of Titan III (Configuration A) during Flight

Martin Subsystem	Design $\bar{R}$ Goal	Before Fix $\bar{R}$ Prediction	After Fix $\bar{R}$ Prediction
Electrical	0.99768	0.99925	0.99925
Flight Control and Hydraulic	0.99206	0.99316	0.99316
Vehicle Safety	0.99990	0.99996	0.99996
MDS (Secondary)	0.99986	0.99992	0.99992
Structure	0.99030	0.99244	0.99244
Ordnance	0.99930	0.99965	0.99965
Propellant and Pressurization	0.98777	0.96070	0.99790
Attitude Control	0.99475	0.90749	0.90749
Payload Fairing	0.99990	0.99995	0.99995
Total	0.96208	0.85825	0.89148

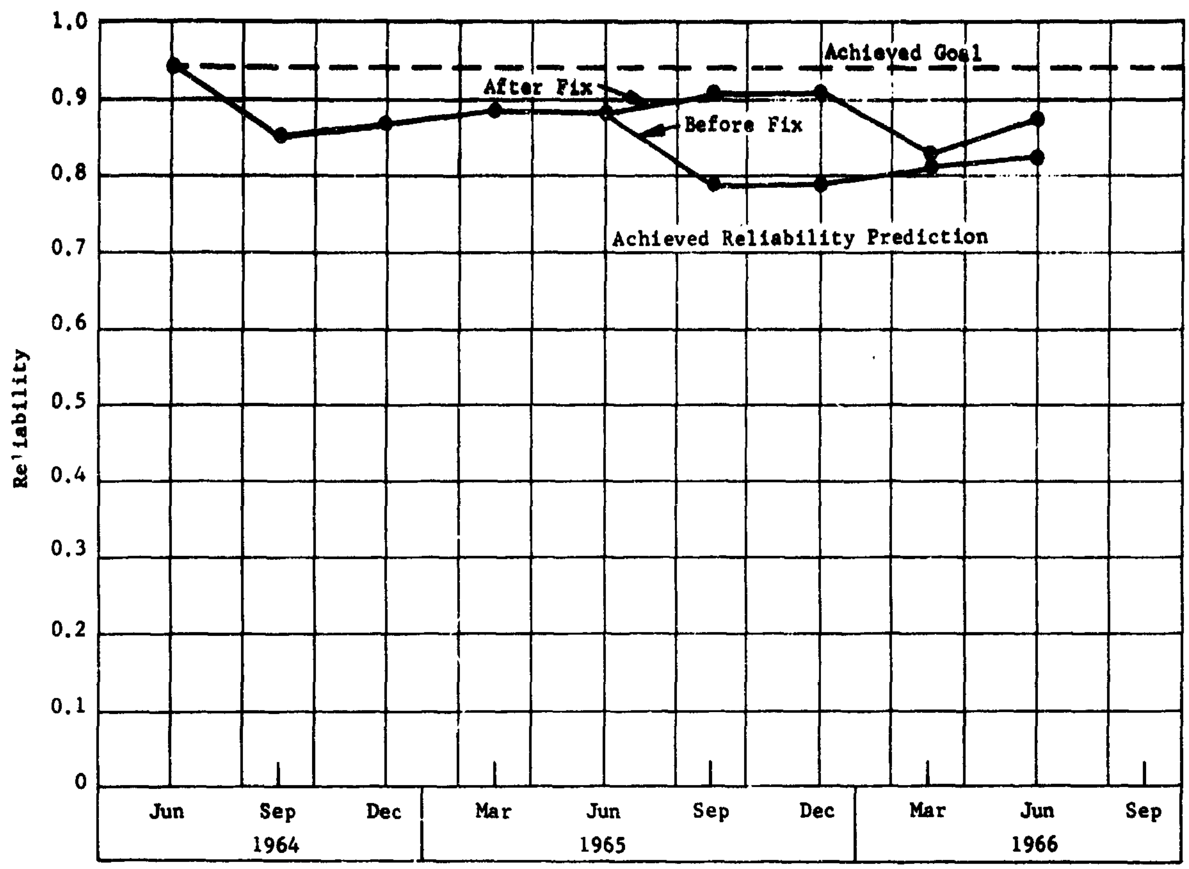

Fig. 9 Achieved Reliability Prediction for Martin Portion of Titan III (Configuration A) during Flight

Table 10 Achieved Reliability Predictions for Individual Subsystems of Titan III (Configuration A) during Flight

Martin Subsystem	Achieved $\bar{R}$ Goal	Before Fix $\bar{R}$ Prediction	After Fix $\bar{R}$ Prediction
Electrical	0.99665	0.97708	0.99222
Flight Control and Hydraulic	0.98837	0.98932	0.98932
Vehicle Safety	0.99986	0.99992	0.99992
MDS (Secondary)	0.99976	0.99985	0.99985
Structure	0.98180	0.98881	0.98881
Ordnance	0.99800	0.99905	0.99905
Propellant and Pressurization	0.97920	0.95684	0.99388
Attitude Control	0.99112	0.90434	0.90434
Payload Fairing	0.99980	0.99989	0.99989
Total	0.93618	0.82605	0.87132

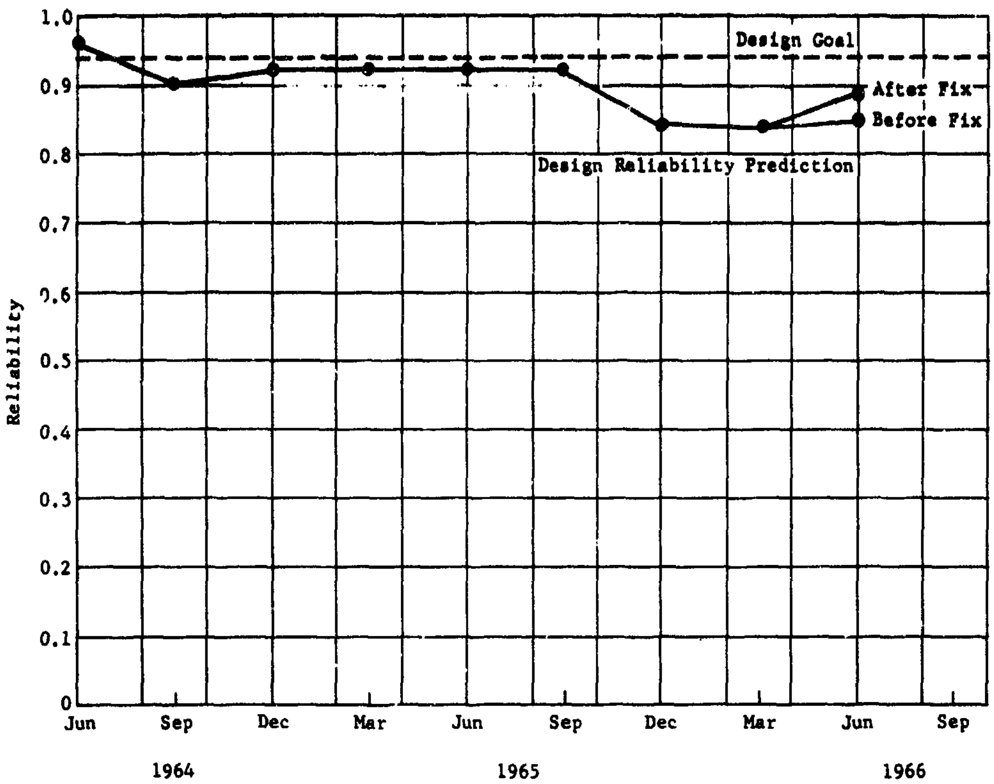

Fig. 10 Design Reliability Prediction for Martin Portion of Titan III (Configuration C) during Flight

Table 11 Design Reliability Predictions for Individual Subsystems of Titan III (Configuration C) during Flight

Martin Subsystem	Design $\bar{R}$ Goal	Before Fix $\bar{R}$ Prediction	After Fix $\bar{R}$ Prediction
Electrical	0.99341	0.99849	0.99849
Flight Control and Hydraulic	0.97120	0.99196	0.99196
Vehicle Safety	0.99990	0.99994	0.99994
MDS (Secondary)	0.99976	0.99986	0.99986
Structures	0.99497	0.99226	0.99226
Ordnance	0.99927	0.99957	0.99957
Propellant and Pressurization	0.98700	0.96051	0.99770
Attitude Control	0.99462	0.90748	0.90748
Payload Fairing	0.99990	0.99994	0.99994
Total Martin	0.94130	0.85609	0.88924

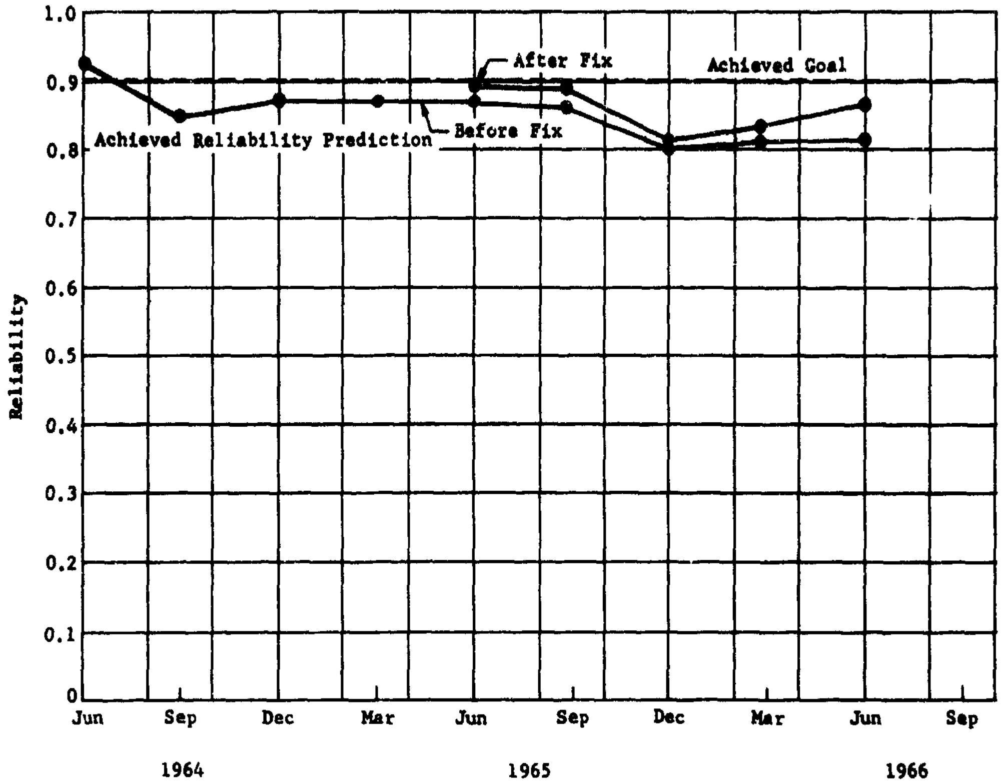

Fig. 11 Achieved Reliability Prediction for Martin Portion of Titan III (Configuration C) during Flight

Table 12 Achieved Reliability Predictions for Individual Subsystems of Titan III (Configuration C) during Flight

Martin Subsystem	Achieved $\bar{R}$ Goal	Before Fix $\bar{R}$ Prediction	After Fix $\bar{R}$ Prediction
Electrical	0.98895	0.97568	0.99084
Flight Control and Hydraulic	0.95190	0.98789	0.98789
Vehicle Safety	0.99970	0.99982	0.99982
MDS (Secondary)	0.99959	0.99971	0.99971
Structures	0.99150	0.98835	0.98835
Ordnance	0.99790	0.99839	0.99839
Propellant and Pressurization	0.97820	0.95613	0.99314
Attitude Control	0.99090	0.90434	0.90434
Payload Fairing	0.99981	0.99987	0.99987
Total Martin	0.90200	0.82192	0.86700

Table 13 Flight Reliability Predication Problem Summary

Article No.	Location	Failure Date	Problem	Class./ Config*	Corrective Action	Problem Status†	Reference Report
1	VTF	5-15-64	Transtage/payload separation SFC E3AA1 did not record during CST. Warped casting probably caused weld to open when unit was bolted in position.	P/A	Action taken to ensure that units comply with flatness specifications before and after potting	Closed, Class 2 6-30-65	FAR A44628
1	D-1	8-6-64	Stage II engine start and staging switch SFC failed to provide output during CST; switch replaced.	P/A	Failure could not be verified during component analysis.	Closed, Class 2 6-30-65	FAR 53379
2	P-20	8-11-64	Stage II/Stage III separation SFC signal did not occur during CST at ETR.	P/A	Found open circuit between E2AA2P1 and B2ASQ4P1; reestablished continuity by tightening connector. Personnel cautioned.	Closed, Class 2 6-30-65	MARS X14231
5	VTF	10-22-64	Transtage/payload separation SFC E3AA1 did not record during CST.	P/A	Broken wire in SFC, isolated failure, no corrective action.	Closed, Class 2 6-30-65	FAR A34551
2	FLT	9-1-64	Transtage oxidizer tank pressurization failed after 189 sec of operation during flight test.	D/A	Regulating solenoid valve failed; EDCS 2996 incorporates crossover system effective Articles 1, 3, and 7; EDCS 3634 provides complete redundancy system, effective Articles 4, 5, 6, 8 and up.	Closed, Class 2 6-30-66	Flt. Test Rpt. EDCS-2996 EDCS-3634
2	P-20	8-11-64	Stage III helium pressure control solenoid failed to operate during CST; wire misterminated.	P/A	Wire was properly terminated per latest engineering change.	Closed, Class 2 6-30-65	MARS X14363
2	P-20	8-25-64	Stage II shutdown signal received at T + 27 sec during CST; bent pin in connector.	P/A	Removed and replaced bent pin; personnel cautioned.	Closed, Class 2 6-30-65	MARS X15589
1	P-20	11-11-64	Transtage propellant crossover SFC failed to fire; suspect open weld, Article 1 only.	P/A	Open weld caused either by potting compound shrinkage, excess warpage, or marginal weld; removed and replaced.	Closed, Class 2 6-30-65	MARS X27971
4	VTF	9-18-64	SRM staging switch late; did not record; open SRM staging resistor assembly.	P/C	Resistor assembly rejected and replaced.	Closed, Class 2 6-30-65	FAR A34498
7	VTF	12-17-64	SRM/Stage I separation aft SFC E1CA4 failed to provide output during CST; short caused by weld ribbon.	P/C	SFC removed and replaced.	Closed, Class 2 6-30-65	MARS 34340 FAR P40316
6	P-20	4-8-65	Stage II/Stage III staging connector L3BP3 left disconnected during CST.	P/A	L3BP3 connected. Repeat run was successful. Personnel cautioned.	Closed, Class 2 7-1-65	MARS X43675
8	FLT	12-21-65	Transtage attitude control system failed during the second transtage coast. The oxidizer valve in Pitch 5 engine module, P/N PD6080147-069, leaked excessively, thus depleting oxidizer supply prematurely	D/C	See Table 3.	Closed, Class 1	Flt. Test RPT.

*P denotes practice failure, D denotes design failure; A denotes Configuration A, C denotes Configuration C.
†Closed denotes corrective action has been taken and problem is considered closed. Class 1 denotes that the corrective action (fix) is not verified; Class 2 denotes that fix is verified. Open denotes problem is considered open with no known corrective action initiated.

Note: Classification of Article 8 flight failure is unknown at this reporting period time, for Reliability Flight Prediction it is being classified as a design failure.

III. RELIABILITY PROBLEMS

On 10 May 1966, the reliability (RAP) and quality engineering corrective action disciplines were consolidated under the quality and system effectiveness department. A new concept of centralized problem identification, action assignment, and corrective action status will be controlled through a corrective action control center (CACC) providing maximum management visibility.

Phone identification of all major impact, safety, mission, and launch critical items, as well as failures that will delay test and/or delivery of replacement hardware, will be made to CACC at the time of occurrence. In addition, all open significant MARS items will be statused until corrective action is completed.

All reference in SSD-CR-63-34 to the Reliability Achievement Program activities involving corrective action will be accomplished by the quality and system effectiveness department. Future quarterly reports of this activity will be included in the Program 624A Quarterly Reliability and Quality Assurance Report, Volume II: Quality Assurance.

A. LEAK TEST FACILITY FAILURES

Approximately 15% of the total MS fittings tested at the leak test facility have leaked. In many instances, leaks were corrected by torquing the joints. Evaluation tests on these joints have revealed conditions such as x dimensions out of tolerance, improper torquing procedures and tools, improper lubrication of bearing surfaces, improper alignment of tubes, soft and hard metal flanges used in the same joint, and unacceptable surface finish on sleeves. An electric corrosion problem has also been identified between MS stainless steel sleeves and aluminum tubing in the airborne propellant and pressurization system.

Personnel have been given special instructions regarding correct methods of lubricating fittings and in the use of x-dimension test gages.

MP35024 was changed 27 January 1966 to clarify the use of the x-dimension gages.

EDCS 04931, effective on Articles 5, 9, and up, has been released to change stainless steel tubing to aluminum.

EDCS 4702, effective on Articles 5, 8, and up, has been released to eliminate the use of lok-tite on all MS fittings except for repair of leaks.

Surface finish specifications have been reviewed and ascertained to be adequate.

EDCS W04953, Supplement B was issued 21 April 1966. This EDCS will require inspection of the sealing surfaces, hardness, roundness, lubrication, sleeve movement, and alignment.

Use of weatherhead inserts has also been evaluated, but they proved unacceptable to propulsion engineering because a contamination trap is created, they impede flow, and they do not stop sleeve movement.

This problem is considered closed.

B. WIRE SPLICES, 58E84 AND 58E104

Additional test and analysis by materials engineering indicate that wire splice seals made from material purchased that meets Martin material specification (MMS) F109 and F113 and processed in accordance with the requirements of engineering process specification (EPS) 85 0861 became questionable. A representative number of splices in accessible locations of built hardware were checked and the zetafin expulsion was determined to be normal.

This problem is considered closed.

C. DIFFERENTIAL PRESSURE TRANSDUCER, AIRBORNE INSTRUMENTATION SYSTEM, PD64S0049-011/013

The problem with the differential transducers PD64S0049-011/013 has been corrected by a redesign that is effective on Articles 5, 9, 10, 13, and up. The modification consisted of coating the strain gages with a moisture resistant material, reduction of the inner diameter of the pressure ports, and decreasing gage cavity volume. A review of system needs also resulted in a change to the zero balance specification from ± 2.0 mv to ± 3.0 mv.

This problem is considered closed.

D. PCM/FM TRANSMITTER, 80801H21000

A recurring problem with the PCM/FM transmitter has been the failure of the Q9 transistor and the 200-vdc module (80801H21120). One failure can possibly be attributed to contamination in the time delay relay 72E38-4; however, extensive testing and examination of several relays from stock leads us to believe that this was a random condition. Extensive testing and design analysis have been performed on the P/A 80801H21050, P/S 80801H21020 and transmitter PD64S0373 without identification of a positive cause of failure. Since most of the recurring failures have been at EMD during acceptance testing, this is not considered a reliability problem.

This problem is considered closed.

E. STRESS/CORROSION OF BOLTS IN THE LAUNCH STRUCTURE AT ETR

Failure of a launch head baseplate bolt occurred at LC-41 following the launch of Article 8. Failure analysis of this broken bolt revealed that the cause of the failure was stress/corrosion. Further investigation of bolts in the launch structure revealed corrosion and that the bolts are susceptible to failure due to corrosion and overstress when torqued to presently specified torque values at ETR. FEDCS B04895 was initiated as interim corrective action for the launch of Article 11. Permanent corrective action was initiated and presented to the customer in EDCS 04895 and was disapproved.

A special inspection of the bolts is now called for by ETO TIII/ETR/00/11 prior to the flights of Article 12 and Article 9.

This problem is considered open.

F. ATTITUDE CONTROL SYSTEM CONTAMINATION (ENGINES)

Data obtained to date indicate that the failure of the transtage attitude control system (ACS) during the flight of Article 8 was caused by contamination in the ACS. During the build and test of Article 14 in Denver, evidence of contamination in the ACS was also discovered.

The problem of contamination and mishandling of the ACS engine modules at Denver has been corrected by issuance of EDCS 04912, effective on Articles 5, 9, and up, which eliminates the installation of flight engines at VTF. Dummy engines will now be installed at Denver for testing, and flight engines will be shipped directly to ETR from Rocketdyne. Inspection of engines that were fit checked and new units received from Rocketdyne and Article 8 failure analysis resulted in the issuance of EDCS C04939, Supplement A (effective on Articles 5, 9, and up) to increase the confidence that the Rocketdyne engines will function properly during vehicle flight. This EDCS revised acceptance criteria at the supplier and revises the engine dash numbers to control a complete turnaround program that establishes a maximum shelf time after cleaning and prior to flight.

This problem is considered closed.

G. UMBILICAL CABLE, PD81S0126

During launch of Article 11, the RB1E umbilical cable, PD81S0126-729, failed to disengage properly, and the airborne half of the connector was pulled from the vehicle. An immediate investigation was initiated to determine the cause of the failure. Review of previous history showed one similar type of failure during test at ETR (failure to release within specified limits of 70 to 200 lb) that was corrected by disassembling, cleaning, and lubricating the connector. Preliminary examination at ETR of the current failed connector, followed by dissection at the vendor, did not reveal a conclusive cause. Additional examination and testing is presently underway at Martin, Denver facility.

This problem is considered open.

IV. DESIGN STUDIES AND REVIEWS

A. RELIABILITY DESIGN STUDIES

There were no reliability design studies reviewed during this quarter.

B. RELIABILITY ANALYSES

There were no reliability analyses conducted by reliability personnel this quarter.

V. ENVIRONMENTAL ACTIVITIES

A. ENVIRONMENTAL TEST PROGRAMS

Design Assurance Test (DAT) Program - All qualification test summary sheets and qualification similarity supplements that were outstanding for the eighth flight article (Article 11) were prepared and submitted to Aerospace/SSD for review and approval during this quarter. Subsequent approval letters were received prior to flight for all items submitted.

In conjunction with qualification of the hydraulic motor pump (PD4800131) for Article 11 use, additional testing was conducted on one unit during this quarter as a result of an Aerospace request. The additional testing consisted of 20 start/stop cycles performed at +185°F and at input voltages of 31.0, 28.0, and 24.0 vdc. In all cases the unit tested performed satisfactorily, and results of this testing were appropriately documented and supplied to Aerospace.

In addition to the efforts related specifically to Article 11, test activities and qualification test summary sheets and qualification similarity supplement submittal activities for subsequent flight articles have continued. A summary of the present component qualification status for the ninth flight article (Article 12) and subsequent flight articles is shown in the tabulation below:

Category	Quantity by Flight No. (cumulative)						
	9	10	11	12	13	14	15
Remaining Test Completions	2	3	5	5	5	5	5
Summary Sheets to be Submitted	3	7	16	20	20	22	56
SSD Approvals Required	3	11	20	24	24	26	60

The above tabulation includes all proposed new components and all proposed revisions to existing components identified as of the date of this report. The large quantity of summary sheet submittals indicated for the fifteenth flight includes necessary revisions to previously submitted and approved summary sheets to include Article 5 use effectivity.

Environmental Acceptance Test (EAT) Program - Environmental acceptance test activities proceeded normally during the past quarter with no significant problems.

Margin-of-Safety Test Program - All test activities associated with the TIIIC margin-of-safety test program have been completed. Test report preparation for the remaining outstanding items of this program is proceeding consistent with manpower and priority requirements of the testing agencies. The margin-of-safety test report for the TIIIC rate gyro system, 80801D30000, was prepared during this past quarter but has not been released as of this reporting date.

A summary of the present status of the margin-of-safety program is presented below:

Total Components in Margin-of-Safety Program	57
Total Components through Test	57
Test Reports Completed	52
Margin-of-Safety Summary Sheets Submitted to Aerospace	52
Margin-of-Safety Summary Sheets Approved by Aerospace/SSD	52

Test Program Plan Revisions - Three revisions to the Design Assurance Test Program Plan, Vol III, SSD-CR-63-34, were organized and formally prepared during this quarter. All of these are presently awaiting action by Aerospace/SSD.

One revision to the Environmental Acceptance Test Program Plan, Vol V, SSD-CR-63-34, was organized and formally prepared during this quarter. This revision has been approved and has been incorporated in the document.

B. VIBRATION ANALYSIS

Article 10 (VELA) Payload Acoustic Study - Acoustic measurements acquired during the Titan III flight program indicated that the acoustic environment occurring within the standard payload fairing of a vehicle during transonic flight exceeds levels which the Article 10 (VELA) payload can withstand. SSP directed the Martin Company to conduct a detailed study of this noise problem. The major elements of the study are: analysis of the acoustic environment inside the payload fairing during transonic flight; development of a vehicle acoustic treatment that will attenuate the environment to a level that the VELA payload can withstand; and preparation of a proposal and cost estimate for installation of the acoustic treatment on the vehicle.

The study comprised two major phases of investigation. The first phase was an analysis of the acoustic environment within the payload fairing. Both theoretical methods and analyses of flight vehicle and scale model test data were used to develop predictions of this environment. The attenuation of the predicted environment provided by a theoretical, but practicable, vehicle acoustic treatment was then derived analytically.

The second study phase included a design study to evaluate possible acoustic treatments and determine an optimum design and a test program to confirm treatment design and evaluate attenuation properties of treatment materials.

An interim report of the Article 10 payload acoustic study was written and submitted to the customer near the end of this reporting period. A preliminary edition was reviewed and approved by SSD/Aerospace at a program status meeting in June 1966.

A final report of this study was in process at the end of the quarter and will be issued early in the third quarter of this year. This report will include definition of the proposed vehicle acoustic treatment, prediction of the payload acoustic environment with the proposed and alternative treatments applied, analyses of the effects of the applied treatment on the vehicle environment and performance, and cost estimates for the proposed and alternative acoustic treatments.

Titan III Acoustic/Vibration Test Program, Phase III - The proposed Phase III of the Titan III acoustic/vibration test program was approved, and a contract for its performance was awarded. This phase of the program will consist of correlating the data from Phases I and II with data to be obtained from Titan II and Titan III flight vibration and acoustic measurements.

This Phase III program was started with the collection and playback of Titan II acoustic and vibration flight test data. To date, approximately 35 Titan II measurements have been played back in the form of time histories. At present, flight times are being chosen for additional analysis of this Titan II data. In addition, approximately 45 Titan III measurements are available and flight times will be chosen from these time histories for additional analysis.

Payload Fairing Vibration Specification - A general random vibration specification was derived for all components mounted on the internal surfaces of the Titan III standard payload fairing. It was derived primarily from data acquired during the acoustic qualification tests performed on a Douglas modified payload fairing. These tests, in which the fairing was subjected to high intensity noise, were conducted during November 1965.

Article 14 Payload Environmental Specifications - Revisions to the Article 14 payload vibration and acoustic criteria specifications were generated, and a series of shock criteria were developed for the four types of payloads to be carried on the vehicle. These proposed new specifications were submitted to SSD for review and approval.

Payload Environment Measurements - Requirements were defined for and action was taken to implement the following new environmental measurements in the payload area during the Titan III flight program:

1) Article 10 - Payload truss acoustic and vibration measurements (one each);
2) Article 11 - Payload area acoustic measurement;
3) Article 12 - Two payload truss acoustic measurements;
4) Article 14 - Payload truss acoustic measurement.

MOL-HSQ Secondary Payload - A review of the Martin and Aerospace material, prepared in response to the requests for action (RFA) issued after the last design review meeting, was conducted with the cognizant Aerospace representative. Concurrence was achieved on all the environmental criteria involved. Aerospace/SSD requested additions to the Martin secondary payload experiment shock data summary, so one RFA remains open.

Information was provided to Aerospace/SSD technical and documentation representatives relative to environmental criteria specified in certain secondary payload experiment interface design requirements documents (IDRD). This information was used in the formal critique of the IDRDs conducted by Aerospace/SSD during the quarter. In addition, interpretations of these criteria were provided for certain experiment contractors as requested.

Special vibration criteria specifications were developed for the heat transfer test capsule and the zero-g propellant gaging experiments and submitted to the experiment contractors.

Instrumentation requirements were defined for shock measurements to be secured during the system test to be performed on a mockup of the plumbing and instrument panel of the fuel cell system experiment. The shock propagation away from the pyrotechnic squib-actuated start valve will be determined from a series of acceleration measurements. The data secured in this investigation will be used to verify certain shock propagation factors used in deriving the shock criteria for the secondary payload experiments.

A meeting of cognizant technical and project representatives was held to examine the environmental criteria revisions to the secondary payload vehicle model specification (MOL-EFT-AVE-1000) which previously had been prepared for incorporation in the latest major revision of the document. It was concluded that certain additional revisions presently are in order, and that other require further confirmation. Completion of this effort and processing of the document revision are planned for the third quarter.

Article 11 Flight Vibration and Acoustic Data - These data are presently being analyzed, and the results of this analysis will be incorporated in the flight test report on Article 11.

C. ENVIRONMENTAL CRITERIA, THERMAL TESTS AND ANALYSIS

The review of all transtage data, including analysis of TET data, has been completed. The component temperature review, which was a part of this study, was also completed. As a result of this study, it was recommended that the 200-amp motor-driven switch (PD72S0068), and the resistor (PD92S0040) be tested to a more stringent temperature environment.

A transtage analytical thermal model was developed during this reporting period. It was used to predict transtage orbital flight temperatures for Article 11 flight. When the actual flight data has been reduced, a comparison will be made between the predicted and actual data to determine the correlation. This technique will be used on all remaining TIIIC flights.

VI. DEMONSTRATION

A cumulative status of reliability demonstration results is shown in Table 14.

Table 14 Status of Reliability Demonstration

Flight Attempt	Article No.	Configuration	Success/Flight Attempt	Failures Excluded Because of Modifications
1	2	A	0/1	0
2	1	A	1/2	0
3	3	A	2/3	0
4	6	A	3/4	0
5	7	C	4/5	0
6	4	C	5/6	0
7	8	C	5/7	0
8	11	C	6/7	1*

*Failure of the regulating solenoid valve (which occurred during Article 2 flight) is excluded, along with the flight attempt, as this failure has not occurred in subsequent flights, and corrective action (see Table 13) is verified to be adequate.

VII. MISCELLANEOUS RELIABILITY ACTIVITIES

During this reporting period, the reliability motivation program was continued which allowed certain persons working with the Titan III hardware to witness launches.

Seven persons from different work areas of the Martin Company and two persons from Rosemont Engineering Company were given an expense paid trip to ETR to tour the facility and to witness the launch of Article 11. The Rosemont Engineering Company of Minneapolis, Minnesota was the recipient of the zero defects supplier of the year award for 1965. The Titan III motivation program was expanded to include the winner of this reward.